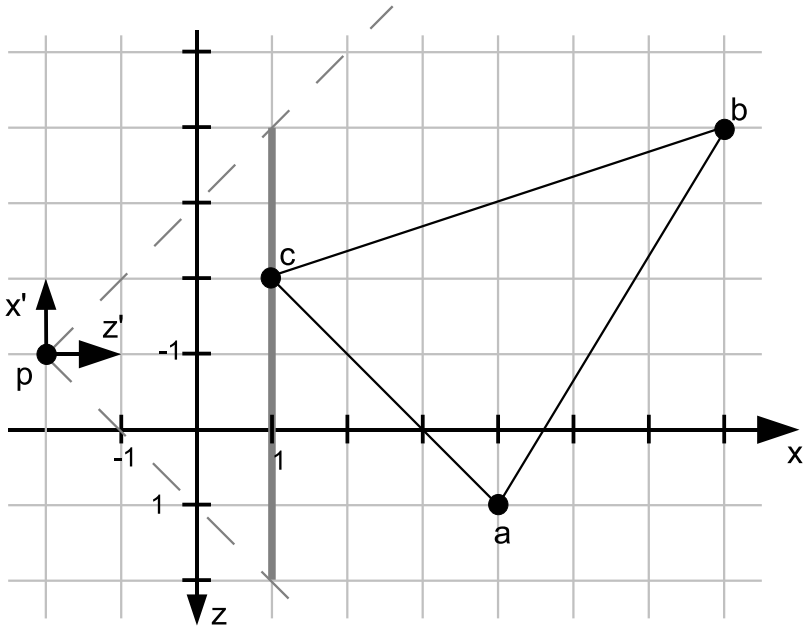
Exercise 2

Data Analysis and Visualization

Computer Graphics - Projection and Shading

Task 1

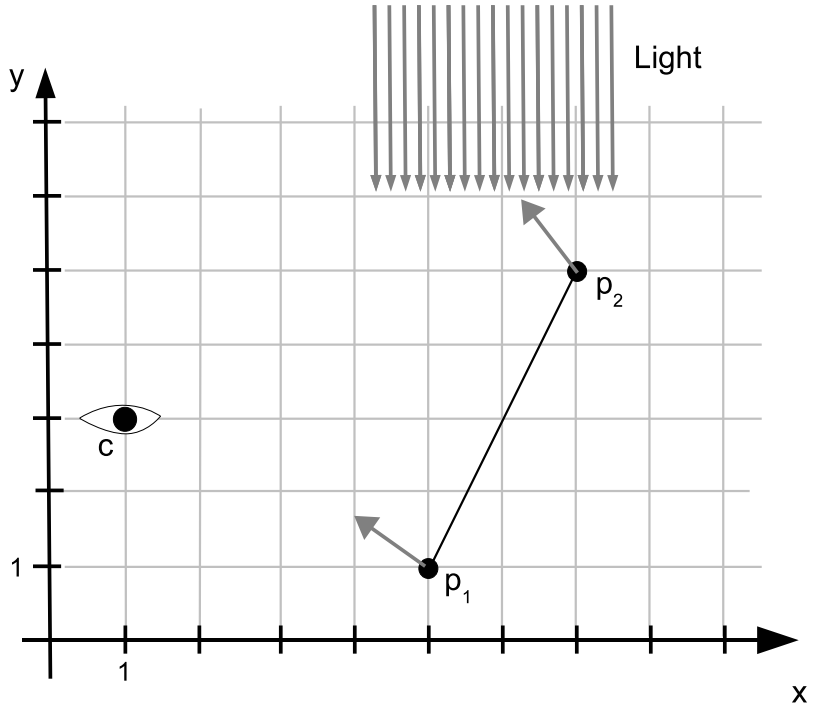


A 3D triangle is defined by $\vec{a} = (4, 2, 1)$, $\vec{b} = (7, -3, -4)$, and $\vec{c} = (1, 3, -2)$. A camera is located at $\vec{p} = (-2, 0, -1)$ and is rotated by 90° around y such that it looks along the global x-axis. The camera performs a simple symmetrical projection onto the projection plane located at $z = 3$ of the camera's local coordinate system.

(a) Transform the three points from the global coordinate frame to the camera's coordinate frame (View-Transformation).

(b) Project the transformed points onto the camera's projection plane and determine the corresponding 2D points on the image.

Task 2



In 2D, a line is bounded by $\vec{p}_1 = (5, 1)$ and $\vec{p}_2 = (7, 5)$ with normals $\vec{n}_1 = (-0.8, 0.6)$ and $\vec{n}_2 = (-0.6, 0.8)$. It is observed by a viewer from $\vec{c} = (1, 3)$.

A light source is positioned infinitely far away on the y-axis, so that the light vector (i.e. the vector from a surface point to the light) is always $\vec{l} = (0, 1)$. The light emits an intensity of $I_i = 1.0$ and $I_a = 0.25$.

All points on the line have an ambient reflection coefficient $k_a = 0.4$, diffuse reflection coefficient $k_d = 0.5$, specular reflection coefficient $k_s = 0.6$, and a specularity factor (i.e. surface roughness) of $s = 4$.

(a) Calculate the light intensity for both points.

(b) The point $\vec{p}_M$ is located on the center of the line betweern $\vec{p}_1$ and $\vec{p}_2$. Calculate its Intensity using Gouraud shading.

(c) Calculate the Intensity of $\vec{p}_M$ using Phong shading.